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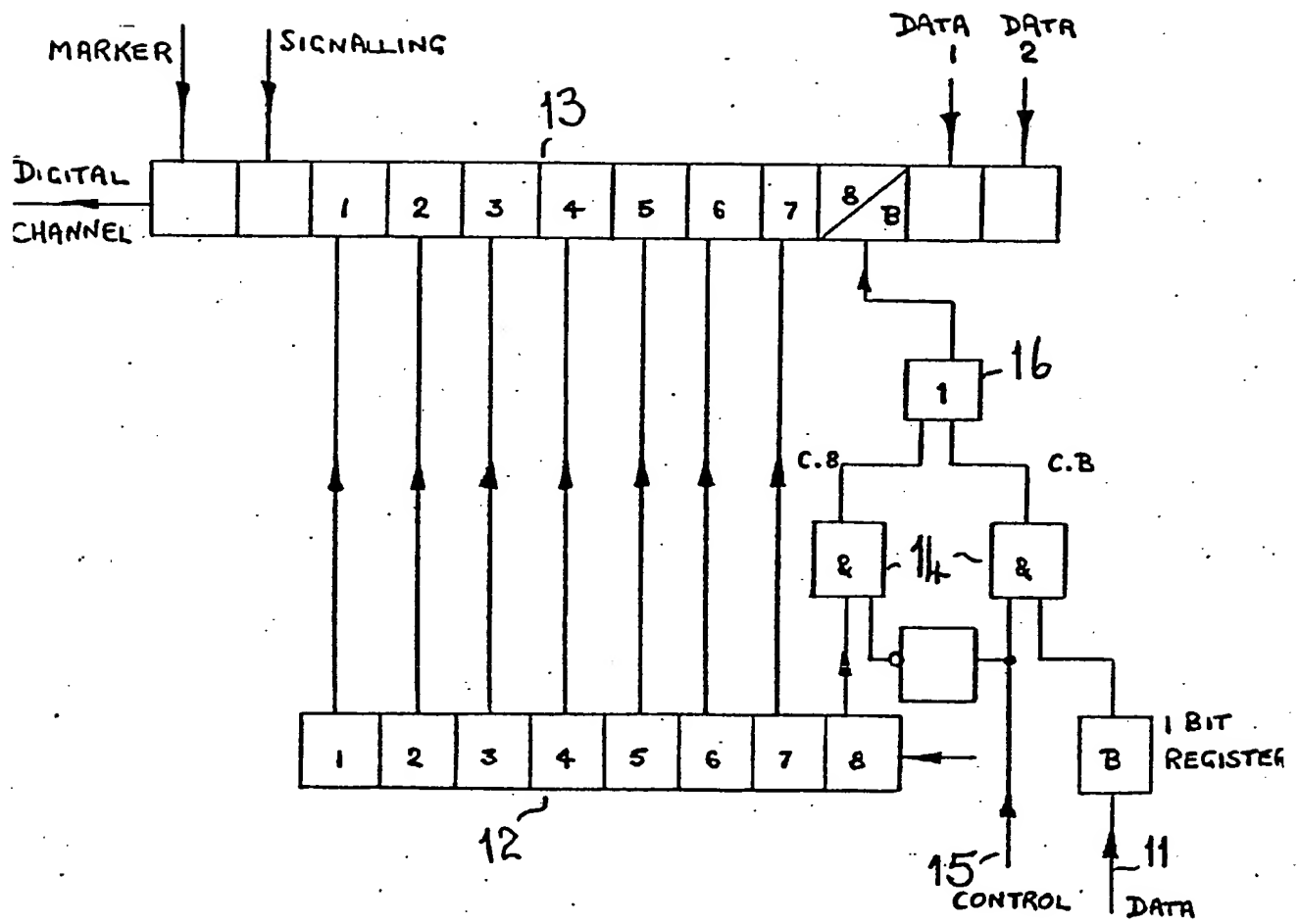
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**(54) Telecommunication systems**

(57) In a telecommunication system in which speech signals are sampled and the sample values digitally encoded for transmission, there are provided means selectively to replace the least significant digits of a sequence of coded samples by a sequence of data digits, whereby the data digits may be transmitted with the encoded speech signals.

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## SPECIFICATION

## Telecommunication systems

The present invention relates to a transmission of data over a digital speech transmission path.

In a telecommunication system in which speech is coded in digital form for transmission within the system, it is a relatively simple matter to multiplex other digital signals such as data signals with the coded speech signals to provide a number of services within the system either related to or independent of the speech channels. Typical services would include viewdata, telewriter, facsimile, metering and alarms. Provision may also be made for signals controlling the transmission network and for directing the various services to the correct destinations.

One area in which such speech and data multiplexing would be particularly useful is the subscribers' network, that is the part of the transmission system between an exchange and its subscribers, since it would enable a subscriber to use data services while holding a normal telephone conversation.

The multiplexing can be achieved by replacing the least significant bit of every eight-bit coded speech sample by a data or a signalling bit, a technique known as "bit-stealing", which allows the data or signalling information to be transmitted with the coded speech at the expense of speech quality. Generally the reduction in quality is not significant subjectively, but on circuits where distortion is present, acceptable standards of speech quality may not be attained.

According to the present invention in a telecommunication system in which each of a succession of samples of a speech signal to be transmitted over the system is digitally encoded for transmission there are provided means selectively to replace a digit of a coded speech sample by a data digit whereby data signals may be transmitted with said speech signals.

Preferably said means operates in dependence upon the value of a control signal to replace the least significant digit of a coded speech sample by a data digit. The means may comprise two registers between which the digits of a coded speech sample may be transferred in parallel selectively with or without the replacement of the least significant digit, which may be effected by gating means between the respective stages of the two registers.

A telecommunication system in accordance with the present invention will now be described by way of example with reference to the accompanying drawing, which shows part of the system schematically.

In the telecommunication system, which may include a conventional telephone system, speech signals to be transmitted over at least some of the transmission paths of the system are sampled periodically and the amplitude of each sample is digitally encoded for transmission, for example in eight-bit compression law format. At any point in the transmission path of the encoded samples there may be provided an arrangement as shown in the drawing, by means of which digital data signals at an

input 11 may be multiplexed with encoded speech signals for transmission with those speech signals.

The arrangement comprises a register 12 into which the eight bits of an encoded sample may be entered serially and from which these bits may be transferred in parallel to another register 13.

The least significant bit of the encoded sample is transferred by way of one of a pair of AND gates 14 one or other of which is enabled by means of a control signal from an input 15, or its inverse, to pass the least significant bit or a data bit to an OR gate 16. The least significant bit stage of the register 13 thereby receives either a speech bit or a data bit, and in the latter case successive eight-bit bytes representing successive encoded samples may carry a predetermined succession of data bits forming a header or framing code to enable the receiving end and demultiplexer to detect that data bits and not speech bits are present.

The eight bits from the register 13 may be read out serially, preceded by a marker bit and a signalling bit, and followed by one or more data bits which may subsequently be routed separately from the eight bits of the multiplexed sample.

When no data is present the full encoded speech sample is transmitted. In practice, even when data is present, in many instances the ratio of simultaneous data to simultaneous speech is very low, so that full speech standards are maintained for a very high percentage of the time. This situation arises because of the following points:

- 1) digital speech bit rates are much higher than many data services so that the ratio of data/speech bits is low,
- 2) natural breaks occur in speaking,
- 3) for many subscriber services, the transmitted data is only intermittent,
- 4) breaks in both speaking and data transmission occur to allow reception from the other end and these breaks would generally be unsynchronised.

## CLAIMS

1. A telecommunication system in which each of a succession of samples of a speech signal to be transmitted over the system is digitally encoded for transmission wherein there are provided means selectively to replace a digit of a coded speech sample by a data digit whereby data signals may be transmitted with said speech signals.
2. A telecommunication system in accordance with Claim 1 wherein said means operates in dependence upon the value of a control signal to replace the least significant digit of a coded speech sample by a data digit.
3. A telecommunication system in accordance with Claim 1 or Claim 2 wherein said means comprises two registers between which the digits of a coded speech sample are arranged to be transferred in parallel selectively with or without the replacement of the least significant digit.
4. A telecommunication system in accordance with Claim 3 wherein the selective replacement of the least significant digit is effected by gating means

between the respective stages of the two registers.

5. A telecommunication system substantially as hereinbefore described with reference to the accompanying drawing.

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